Package

[0001] This invention relates to packages for substances or mixtures of substances, in particular perishable goods such as foods or drugs.

[0002] It is intended to open up possibilities for checking the content of the package without destroying the latter. For example, a possibility should be provided for checking foods which are contained in packages as to whether they can still be consumed or their state has deteriorated such that they can result in damage to organisms.

[0003] It is hitherto customary to print expiration dates on packages or to take samples of the ingredients out of a package at certain places and subject them to a subsequent external analysis. In the last-named case it is necessary to open the package or at least make a small opening which cannot always be completely closed after sampling.

[0004] It is therefore the problem of the invention to propose a possibility for checking the state of substances or mixtures of substances contained in packages without destroying the package.

[0005] According to the invention, an optically readable sensitive element is therefore contained within the package.

[0006] The optically sensitive element used here may be a sensitive layer or membrane alone or such a membrane or layer attached to the sensitive element.

[0007] Thus, such a membrane or layer can change its layer thickness, refractive index, scattered light properties as well as spectral properties in the UV, VIS, NIR, IR through corresponding physical and/or chemical state changes within the package, but also time-dependently, and the particular change then be used as a measure of the particular state.

[0008] By optical means for example, one or simultaneously several such changes can be determined by means of interferometry, spectroscopy but also by surface plasmon resonance.

[0009] Layer thickness changes can occur for example dependently on concentration. Thus, an oxygen concentration, the hydrocarbon concentration, the hydrogen concentration or water contained within the package can affect the layer thickness, for example by reversible swelling.

[0010] In some cases, however, a temperature- or pressure-dependent change can also lead to layer thickness changes.

[0011] It is also possible to use per se known membranes or layers containing or exhibiting one or more dyes or selective markers. Such dyes or markers can luminesce, for example, and a state-dependent change in intensity, phase or decay time of luminescence can be used as a measure of the state of substances or mixtures of substances contained in packages.

[0012] For example, it is known that certain luminescence dyes luminesce to varying degrees under the influence of oxygen in dependence on the concentration thereof or the oxygen partial pressure, or the luminescence decay time behavior changes accordingly, so that this can be utilized with an optical detector from outside upon simultaneous or sequential irradiation with a light source emitting light in a wavelength range exciting luminescence.

[0013] The invention can also be used to detect changing pH values within the package.

[0014] It is possible to immobilize or fix a sensitive membrane or layer directly onto the inner wall of the package, possibly using for example a transparent adhesive film which can be bonded into the package.

[0015] The membrane or layer can also be attached or fixed on a separate element which is for example fixed in a frame, and said frame can in turn be connected to the package.

[0016] In some cases, and with suitable substances or mixtures of substances contained in packages, it is also possible to simply insert sensitive elements into the package.

[0017] Further, the sensitive element can be directly part of the package, for example by bonding or welding, or be the package itself.

[0018] For detection by optical means, at least a partial area of an inventive package should be transparent for the measurement procedure, for example optically in the corresponding wavelength range, or have a transparent window. This permits for example a color change occurring because of a fault or a leak in the package to be readily recognized from outside.

[0019] The layers or membranes can be provided with optical, mechanical or chemical protective layers to prevent undesirable influences on the layers or membranes.

[0020] Such protective layers should if possible be permeable to substances to be detected, which can be achieved for example by accordingly thin metal layers. Such thin metal layers, preferably consisting of noble metals, particularly preferably of silver, provide protection from extraneous light and moisture, but are still sufficiently permeable to many gases if accordingly thin.

[0021] Further, information can be applied. It can comprise for example calibrating data, batch numbers.

[0022] Said information can also be transmitted by a radio frequency identification (RFI) chip mounted on the membrane/layer.

[0023] Extending the membrane/layer by an integrated, compact evaluation unit permits direct processing of the measuring signals. Said evaluation unit can be supplied with energy or transfer the signals (measuring data/control commands) for example by means of electromagnetic waves.

[0024] With aggressive media, protective layers of PTFE or PTFE-based layers can be formed on membranes or layers.

[0025] Further, protective layers can advantageously be made of dielectric material. For example, a SiO2 sol-gel is to be stated here.

[0026] Further, it is possible to construct protective layers from optically reflective or absorbent lacquer layers, preferably based on synthetic resin lacquers or acrylic lacquers.

[0027] It is also possible to dispose a plurality of such layers one above the other.

[0028] A calibration of the sensitive elements can be done when the package is being closed by adjusting specific pressures, a vacuum and a corresponding excess pressure being adjustable.

[0029] It is also possible to perform a selective supply of a calibrating gas of known gas composition or supply of calibrating liquid or a temperature variation for calibration.

[0030] Calibration can also already be done before the sensitive element is incorporated into the package. For this purpose it is possible to use an external calibrating module in which defined changes of the measurand, for example defined pressure changes, can be adjusted.

[0031] The inventive solution can be used to carry out a monitoring of the substances or mixtures of substances contained in packages repeatedly over long time periods, without there being any possible influence of the environment from outside into the package.

[0032] The monitoring can correspondingly be carried out over the entire transport and storage chain up to the final consumer, so that increased consumer protection is attainable.

[0033] It is unnecessary to take samples from the package, and no corresponding additional sampling elements are required for this purpose.

[0034] For detection of the state it is possible to use per se known, preferably optical, measuring technology, which can for example be placed against a transparent area of the particular package from outside.

[0035] It is thus possible that a suitable optical system with a light source whose light is guided for example by a flexible optical waveguide is placed against the particular package from outside and the light of the light source directed onto a membrane or layer. and an optical change occurring on or in the layer can be directed onto an optical detector for example by said optical waveguide or a further optical waveguide.

[0036] A measuring head from which excitation light and/or reflected or emitted light can be directed onto the optical detector should be so formed that the influence of scattered light is at least reduced or constant.